

**$^{180}\text{Ta}(\gamma, \gamma')$ : target= $9^-$  isomer    2002Be18,2002La01**

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	E. A. Mccutchan	NDS 126, 151 (2015)	1-Feb-2015

The  $^{180}\text{Ta}$  (Target= $9^-$  isomer)( $\gamma, \gamma'$ ) reaction is important in nuclear astrophysics for explaining the abundance of  $^{180}\text{Ta}$  in stellar matter. The unusually large integrated cross section ( $\sigma \Gamma$ ) for the  $^{180}\text{Ta}$  (Target= $9^-$  isomer) ( $\gamma, \gamma'$ )  $^{180}\text{Ta}$  (8.1 h) reaction reported by 1988Co04, 1989Ca19 have raised the concern that evolution of this isotope may be affected by photoexcitation at the s-process temperatures. However, the energies of the resonant states (2.8-3.6 MeV) measured by 1990Co24 are high enough to insure the survival of this nucleus in an s-process environment. A disagreement between 1992Ne02 and 1990Co24 regarding the magnitude of the integrated cross sections still remains an open question.

2002Be18, 2001Vo13, 1999Be65: Target:  $\text{Ta}_2\text{O}_5$  target enriched 5.45%  $^{180\text{m}}\text{Ta}$  containing 6.7 mg of  $^{180\text{m}}\text{Ta}$  ( $>1.2 \times 10^{15}$  y); 123 mg/cm<sup>2</sup> of  $\text{Ta}_2\text{O}_5$  powder and natural Ta metal targets. Bremsstrahlung with 1.5 MeV end point energy. Measured  $E\gamma$ ,  $I\gamma$  in photon scattering experiment with three Ge detectors at 90°, 127°, and 150°. The detector at 127° was surrounded by a BGO anti-Compton shield. In activation measurement, measured  $E\gamma$ ,  $I\gamma$ , x-rays with two high resolution LEP detectors; deduced  $T_{1/2}$  of ground state.

2002La01: Target: natural Ta disc of diameter 40 mm and thickness 0.33 mm. Projectile: 1.85 PBq  $^{60}\text{Co}$  source. Planar Ge detector surrounded by NaI anti-coincidence shield. Partial lifetime for intermediate states.

2001Wa45: Interpretation of the states observed in 2002Be18, 1999Be65.

1990Co24: Target: 99.95% enriched  $^{180}\text{Ta}$  containing  $^{180}\text{Ta}$  ( $>1.2 \times 10^{15}$  y) in its natural abundance. Bremsstrahlung from tantalum irradiated with electrons. Fourteen different endpoints of the bremsstrahlung were arranged to span the interval from 2 to 5 MeV. Uncertainties in the end points were less than 50 keV. Standard calculations provided the photon flux for the various electron energies, and these calculated values were verified using the  $^{87}\text{Sr}(\gamma, \gamma')^{87}\text{Sr}$  (2.8 h) reaction. A measurement of HF K x-ray with  $\alpha$  decay rate consistent with  $T_{1/2}=8.1$  h suggested that these high-energy states cascade through the levels of  $^{180}\text{Ta}$  leading finally to the ground state. Detector: hyperpure germanium. Measured integrated cross sections of  $\sigma \Gamma=120$  mb keV 20 and  $\sigma \Gamma=350$  mb keV 50 for depopulating  $^{180}\text{Ta}$  ( $>1.2 \times 10^{15}$  y) through resonant states at 2.8 MeV 1 and 3.6 MeV 1, respectively. The 3.6 MeV resonance has not yet been observed in other experiment.

Others: 1988Ca04, 1989Ca19, 1992Ca01, 1992Ca01, 1992Ne02, 1994Ka54, 1995BeZX, 1997Be58, 1997Be76, 1998BeZY, 1998Ka14, 1999Bi08, 1999Bi21, 1999To05, 2001Kn02, 2001So17, 2002Ga14, 2011Vy02.

 $^{180}\text{Ta}$  Levels

E(level) <sup>†</sup>	$J^\pi$	$T_{1/2}$	Comments
0.0	$1^+$	8.18 h 2	$T_{1/2}$ : from $K\alpha$ x-ray(t) (2002Be18). Other: 8.15 h 3, early result by same group (1999Be56).
77.1 8	$9^-$	$>7.1 \times 10^{15}$ y	E(level), $T_{1/2}$ : from the Adopted Levels.
1087 10		$\leq 35$ ps	$T_{1/2}$ : from partial meanlife of 40 ps 11 (2002La01). E(level): identified as the 1076 keV $J^\pi=(8^+)$ level in 2001Wa45.
1300 20		$\leq 7$ ps	E(level): identified as the 1278 keV $J^\pi=(9^+)$ level in 2001Wa45. $T_{1/2}$ : from partial meanlife of 9.3 ps 4 (2002La01).
1510 20			E(level): identified as the 1499 keV $J^\pi=(10^+)$ level in 2001Wa45.
1630 30			
1930 50			
2240 20			
2480 60			
2720 30			
2880 40			

<sup>†</sup> From 2002Be18, except for the 1087-keV level which is from 1999Be65. Excitation energy of the  $9^-$  isomer (77 keV) has been added by the evaluator to the energies given in 2002Be18 and 1999Be65.